DOE-ID ARCHITECTURAL ENGINEERING STANDARDS	TITLE:	EXTERIOR ELECTRICAL UTILITY SERVICE		
	DATE:	September 2002	SECTION:	1630

1630-1. CODES AND STANDARDS

1.1 Applicable Codes and Standards

- AES 0100-1, Codes and Standards
- AES 1600-1.1, Applicable Codes and Standards

1.2 Referenced Codes and Standards

- ANSI/IEEE C37 series, Circuit Breakers, Switchgear, Relays, Substations and Fuses
- ANSI/IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
- ANSI/IEEE 399, Recommended Practice for Power Systems Analysis
- ANSI/IEEE 493, Recommended Practice for Design of Reliable Industrial and Commercial Power Systems
- REA Bulletin 50-1 Standard T-805B
- REA Bulletin 50-3 Standard D-804
- REA Bulletin 50-6 Standard D-806
- Factory Mutual Loss Prevention Data Sheet 5.4.

1630-2. GENERAL

2.1 Exterior electrical systems shall be designed and constructed with regard to existing electrical system construction in adjacent areas. Relaying shall comply with IEEE 242, and switchgear shall comply with IEEE C37 series.

2.2 **Load Requirements** Demand and diversity factors shall comply with NFPA 70. Electrical service quality and reliability shall be considered in conformance with IEEE 493 to ensure that they meet the load requirements. Where loads require a high degree of voltage and frequency stability, the available short-circuit current (AIC) at the service connection and the stability of the supplying utility system shall be considered to ensure adequate power supply.

2.3 **Power Factor** An overall power factor of not less than 85 percent shall be achieved. Switched capacitor banks shall be used only when necessary to prevent over voltages during off-peak hours during low power consumption. Starting capacitors shall be located as near to the loads as practical. Starting capacitors shall be switched simultaneously with load.

2.4 **Redundancy** Facilities designated as critical by the project design criteria shall be served by dedicated redundant circuits. The two services should be separated by a 4-hour fire-rated barrier and should be served from separate sources. In lieu of providing two separate services, a single service may be provided when the reliability of the single service proves adequate when

considered in conformance with IEEE 399 and IEEE 493.

2.5 **Metering** Electrical energy (kWh) metering shall be furnished at each substation of 500 kVA or larger capacity. Demand (kW) metering shall be furnished as required for load management purposes.

1630-3. OVERHEAD LINES

3.1 **General** Joint use of pole lines for electrical, alarm, and communication conductors shall be made wherever possible; alarm lines shall generally be the lowest lines on the structure. Pole lines, 601 V and higher rated, shall comply with NEC Article 710, NESC and shall be generally designed in accordance with the recommendations of the Rural Electrification Administration (REA) Bulletins listed above. Lines shall be a Grade B, Class 2 construction, minimum, or equivalent. Poles shall be pressure treated in accordance with ANSI 05.1. Poles may also be protected with the use of solid wood preservative boron rods containing disodium octoborate to replace boron lost from the poles. Federal Specification TT-W-00571 J, or latest edition, shall apply. For lines rated 15 kV and lower, details of construction shall comply with REA Form 804. Lines rated 600 V or less shall follow the above requirements where appropriate and shall specifically meet the strength, size, and treatment requirements.

3.2 **Minimum Clearance** Clearance shall assume that all areas are accessible to truck traffic unless physically barriered to preclude such traffic. Clearances over major access routes shall comply with NESC. Minimum vertical clearances in traffic corridors should be provided in the design criteria. In areas frequented by truck traffic with loads of greater than ordinary height, consideration shall be given to burying the line.

3.3 **Design Criteria for Overhead Pole Lines at the INEEL Site** The environmental conditions to be considered in the design of overhead transmission, distribution, and communication lines are as follows:

Loading District	Heavy
Extreme Wind Loading	16psf
Ice Loading	0.50 in.
Design Low Temperature	-50˚F
Design High Temperature	100˚F

3.4 High Voltage Termination on Pole Lines

(a) Cutouts shall be 15 kV loadbreak.

(b) Termination of 5 kV to 25 kV rated lines shall use termination kits that meet IEEE 48 Class I standards.

1630-4. UNDERGROUND AND EMBEDDED DUCTS AND CONDUIT

4.1 In congested areas, where required for safety or conformance with facility practice, power distribution circuits shall be placed underground. Underground cables and ducts shall be suitably identified. All circuits for power, telephone, alarms, etc., to be placed underground in areas outside of buildings in plant areas shall be run in conduit in concrete encasements (Duct Bank). In general, the minimum size conduit shall be 2 in., with the exception of simple runs of conduit to dedicated equipment. These shall be sized for the applications, with a 3/4 in. minimum. All concrete used to encase underground electrical duct banks shall be colored red. See the appropriate drawing listed in Appendix D for further details.

4.2 Underground runs for power, telephone, alarms, etc., outside of plant areas, for temporary installations, or for areas where future excavation will be minimal, may be direct burial cable or moisture-proof cable installed in RGS conduit. At the INTEC buried RGS shall be either cathodically protected or be PVC coated RGS. All conduit bends over 30 degrees shall be rigid steel conduit. Splices in direct-burial cable shall be made with splice kits that provide an approved waterproof splice.

4.3 Underground installations shall be installed and buried to depths specified in NEC and shall have a locator ribbon installed. See Section 0200 for locator ribbon requirements. Cable route marking signs showing the depth of burial shall be installed at 300 ft intervals or within sight distance along the route. Non-marking of cable routes may be allowed if directed in the project design criteria under the following special conditions:

(a) security

(b) sensitive control for reactors

(c) where marked routes are inappropriate for similar reasons.

4.4 All spare ducts and conduits shall contain a pull rope to facilitate future pulling.

4.5 Underground duct or utility corridor that penetrate security barriers shall provide the same resistance as the barrier. This provision applies when the free area within the duct run or corridor is more than 96 square inches in area and over six inches in smallest dimension.

1630-5. MANHOLES

The AE shall use standard telephone and electrical manholes shown on drawings listed in Appendix D. Cables shall be racked. Racks and other exposed conducting material shall be bonded together and grounded. Cables of different voltage classes shall be separated to the maximum extent. Communication cables shall not be located in manholes with power cables unless required by existing conditions, separated by a physical barrier with a dielectric strength equal to the highest voltage in the manhole, and permitted by the design criteria. Communication cables associated with the power cables, such as SCADA shall be allowed. Pulling eyes shall be installed in each manhole.

1630-6. TRANSFORMER INSTALLATIONS

6.1 All transformers shall be installed per the requirements of FM Loss Prevention Data Sheet 5-4 and the NEC.

6.2 All ground level oil filled transformers, switches, or electrical equipment containing more than 50 gal of electrical insulating oil shall have containment installed to minimize spill remediation. The containment shall be concrete or other evaluated material meeting NEC requirements.

1630-7. SWITCHYARDS, TRANSFORMER YARDS, SUBSTATIONS

See Section 0200-3 Outdoor Substations.